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(54) Method and apparatus for processing a Cell Update Confirm message in a 3rd Generation Wireless Telecommunication System

(57) A method and apparatus for processing a message in a mobile telecommunications device. The method comprises:

receiving a Cell Update Confirm (CUC) message;
determining whether the device has an empty C_RNTI variable;
when the device has an empty C_RNTI variable, determining whether the CUC message includes a new C_RNTI ;

when the CUC message includes a new C_RNTI and the CUC message would cause the device to enter a state which requires the UE to respond to the message before entering the state, carrying out at least one further step prior to entering the state.

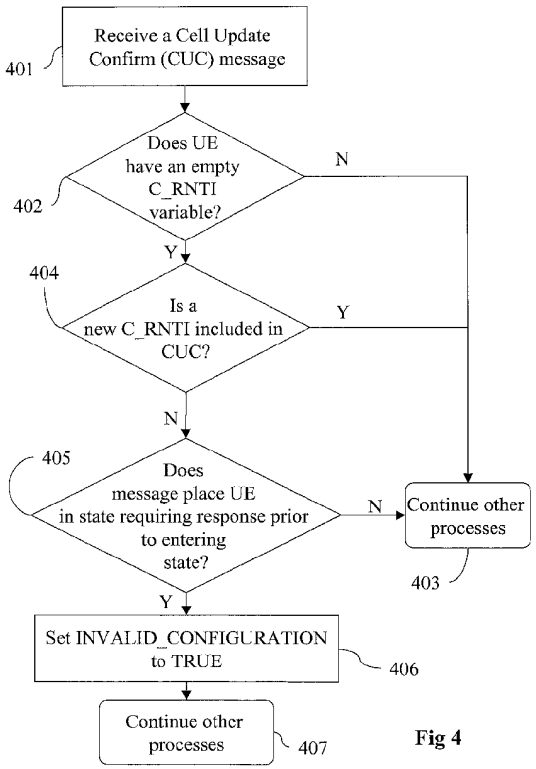

Fig 4

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of telecommunications and particularly to the area of wireless telecommunication systems.

BACKGROUND OF THE INVENTION

[0002] In a typical cellular radio system, mobile user equipment (UE) communicates via a radio access radio network (RAN) to one or more core networks. User equipment (UEs) comprises various types of equipment such as mobile telephones (also known as cellular or cell phones), lap tops with wireless communication capability, personal digital assistants (PDAs) etc. These may be portable, hand held, pocket sized, installed in a vehicle etc and communicate voice and/or data signals with the radio access network.

[0003] The radio access network covers a geographical area divided into a plurality of cell areas. Each cell area is served by at least one base station, which may be referred to as a Node B. Each cell is identified by a unique identifier which is broadcast in the cell. The base stations communicate at radio frequencies over an air interface with the UEs within range of the base station. Several base stations may be connected to a radio network controller (RNC) which controls various activities of the base stations. The radio network controllers are typically connected to a core network.

[0004] An example of a radio access network is the Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access Network (UTRAN). UMTS is a third generation mobile communication system and essentially relates to a wide band code division multiple access (W-CDMA) system.

[0005] W-CDMA technology allows simultaneous communication between user equipment and a plurality of base stations using a common frequency band. Signals occupying a common frequency band are discriminated in the receiving base station through spread spectrum CDMA waveform properties based on the use of a high speed, pseudo-noise (PN) code. These high speed PN codes are used to modulate signals transmitted from the base stations and the user equipment. A transmitting station uses a PN code to produce signals that can be separately demodulated at a receiving station. In CDMA therefore a user equipment unit need not switch frequency when handover of the connection is made from one cell to another. Thus, a destination cell can support a connection to the user equipment at the same time as the original cell continues to provide service. Since the UE is always communicating through at least one cell during hand over, there is no disruption to the call.

[0006] There are several interfaces defined in the UTRAN. In some instances a connection involves both a serving or source RNC (SRNC) and a target or drift RNC (DRNC), with the SRNC controlling the connection but with one or more diversity legs of the connection being handled by the DRNC. UMTS has both common transport channels and dedicated transport channels. Common transport channels include the random access channels (RACH), the forward access channel (FACH), the common packet channel (CPCH) and the downlink shared channel (DSCH). Dedicated transport channels include the dedicated channel (DCH). These transport channels are described for example in one or more of the following specifications:

ETSI TS 125.211 Version 3.12.0 "Physical Channels and Mapping of Transport Channels on to Physical Channel (FDD)";
ETSI TS 125.221 Version 3.11.0 "Physical Channels and Mapping of Transport Channels on to Physical Channel (TDD)";
ETSI TS 125.331 Version 3.15.0 "Radio Resource Control (RRC) Protocol Specification.

[0007] When switching from a dedicated to a common channel in UMTS, the UE is assigned a temporary identifier known as C-RNTI (Cell Radio Network Temporary Identifier). This temporary identifier C-RNTI is specific to a cell and is valid in the cell where the UE uses resources. The C-RNTI is used to distinguish between different user equipment in that cell.

[0008] When switching from dedicated channels to common channels, the network can assign the radio resources to be used only if the UE is in a cell under control of the serving SNC (SRNC). In other words, if the UE is in a cell under the control of a drift RNC (DRNC) rather than SRNC, it is not possible for the network to assign the radio resources to be used when switching from dedicated channels to common channels. This results in longer signalling sequences between the UE and the network as well as additional delay when switching from dedicated channels to common channels. The UE itself must obtain the temporary identifier C-RNTI by additionally signalling between the UE and UTRAN before continuing to communicate with the network. Furthermore, the lack of information regarding which range of resources to use means that the UE needs to detect and read information about the range of resources and the broadcast channel in the cell before accessing the cell. This again incurs additionally delay when switching from dedicated channels to common channels.

BRIEF DESCRIPTION OF DRAWINGS

[0009] The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements and in which:

Fig. 1 shows a schematic diagram of a radio access

network system;

Fig. 2 shows the components of a user equipment used with the radio access network system of figure 1;

Fig.3 illustrates the cell update procedure used with a radio access network system as shown in Fig.1;

Fig. 4 is a flow chart illustrating the operation of a first embodiment of a system;

Fig. 5 is a flow chart showing a second embodiment of the system;

Fig. 6 is a flow chart showing a third embodiment of the system; and

Fig. 7 is a flow chart showing a fourth embodiment of the system.

[0010] The needs identified in the foregoing Background, and other needs and objects that will become apparent from the following description, are achieved by, in one aspect, a method for processing a message in a mobile telecommunications device. The method comprises, on receipt of a Cell Update Confirm (CUC) message, determining whether the device has an empty cell identifier variable e.g. C_RNTI. When the device has an empty cell identifier variable, it is determined whether the CUC message includes a new cell identifier e.g. C-RNTI. If this is the case, and the CUC message would cause the device to enter a state which requires the UE to respond to the message before entering the state, at least one further step is carried out prior to entering the state.

[0011] In other aspects, the invention encompasses apparatus and a computer-readable medium configured to carry out the foregoing steps. In particular, the method may be implemented in a mobile telecommunications device, with or without voice capabilities, or other electronic devices such as handheld or portable devices.

[0012] Figure 1 shows an overview of the radio access network (UTRAN) used in a UMTS system. The network as shown in Figure 1 comprises three Radio Network Subsystems (RNS) 2. Each RNS has a Radio Network Controller (RNC) 4. Each RNS 2 has one or more Node B 6 which are similar in function to a Base Transmitter Station of a GSM radio access network. User Equipment UE 8 may be mobile within the radio access network. Radio connections (indicated by the straight dotted lines in Figure 1) are established between the UE and one or more of the Node Bs in the UTRAN.

[0013] A radio network controller RNC controls the use and reliability of the radio resources within the RNS. Each RNC is also connected to a 3G mobile switching centre 10 (3G MSC) or a 3G serving GPRS support node 12 (3G SGSN).

[0014] An RNC controls one or more Node B's. An RNC plus its Node B's together make up an RNS. A Node B controls one or more cells. Each cell is uniquely identified by a frequency and a primary scrambling code (primary CPICH in FDD, primary CCPCH in TDD).

[0015] Generally in UMTS a cell refers to a radio network object that can be uniquely identified by a UE from a cell identifier that is broadcast over geographical areas from a UTRAN access point. A UTRAN access point is a conceptual point within the UTRAN performing radio transmission and reception. A UTRAN access point is associated with one specific cell i.e., there exists one UTRAN access point for each cell. It is the UTRAN-side end point of a radio link.

[0016] C-RNTI, the Cell Radio Network Temporary Identity, is a UE identifier allocated by the controlling RNC and it is unique within one cell controlled by the allocating CRNC. C-RNTI can be reallocated when a UE accesses a new cell with a cell update procedure. C-RNTI is used as a UE identifier in DCCH/DTCH common channel messages on the radio interface.

[0017] Figure 2 shows a schematic diagram of various components of UMTS user equipment. The UE 8 includes an antenna 80 and a transceiver 82 for transmitting and receiving radio signals. In the Time Division Duplex (TDD) mode of UMTS, the transceiver 82 may use a rake receiver to establish the signal to be operated on by the UE. The transceiver 82 is connected to a processor 84 which processes the signals received by and sent by the transceiver. The processor 84 has connections to memory 86 and a user interface device 88 (such as a keyboard and/or a screen). Figure 2 only shows the main components of the UE. Clearly the UE will include other components which are not shown but which are not relevant for the present understanding.

[0018] Figure 3 shows the cell update procedure in UMTS. Firstly the UE sends a cell update to the UTRAN. ETSI TS 125.331 Version 03.15.00 Section 8.3.1.5 describes what occurs at the UTRAN when the UTRAN receives a cell update message from a UE. Among other things, the UTRAN transmits a cell update confirm (CUC) message. ETSI TS 125.331 Version 03.15.00 Section 8.3.1.6 describes the operation of the UE on reception of a cell update confirm message from the UTRAN. The UE may in response send a Physical or Transport Channel Configuration Complete message or any other suitable message or possibly no response message.

[0019] Figure 4 is a flow diagram illustrating one example of how the UE may react to receiving a CUC message.

[0020] On receipt (step 401) of a cell update confirm message, firstly the UE checks (step 402) whether the C_RNTI variable of the UE is empty. If not, the UE carries out further processes (step 403) which will not be discussed further. However, should the C_RNTI variable be empty, the UE then checks whether a new C-RNTI is included in the received CUC message (step 404). If a new C-RNTI is included in the CUC message, the UE continues with other processes (step 403) which will not be discussed further. However, should the CUC not include a new C-RNTI then the UE checks whether the CUC message would place the UE in a state requiring

a response prior to entering the state (step 405). If this is not the case, the UE continues to further processes which will not be discussed further. However, if the CUC message does place the UE in a state that requires a response prior to entering the state, the UE takes further action as set out in step 406.

[0021] As shown in Figure 4, this step 406 comprises setting the variable INVALID_CONFIGURATION to TRUE thus the processing of the CUC message is aborted. The UE then may continue with further processes (step 407) such as sending a subsequent cell update message to the UTRAN or returning to idle. This decision may depend on the value of V302 and N302 as described in Section 8.3.1.9 of ETSI TS 25.331 Version 3.15.0.

[0022] Figure 5 shows a further embodiment. Steps 501, 502, 503, 504 and 505 are the same as steps 401 to 405 described with reference to Figure 4. However, as shown in Figure 5, in this embodiment when a message would place the UE in a state requiring response prior to entering the state (step 505), then the UE sends a new cell update message with the cause set to "cell reselection".

[0023] Figure 6 shows a further embodiment in which steps 601 to 605 are the same as steps 401 to 405 as described with reference to Figure 4. However, when the CUC message places the UE in a state requiring response prior to entering the state, in this embodiment the UE acts on the cell update confirm message but does not respond to the UTRAN (step 606).

[0024] Figure 7 shows yet a further embodiment in which step 701 to 705 correspond to steps 401 to 405 of Figure 4. However, when the message places the UE in a state requiring a response prior to entering the state, the UE simply ignores the CUC and takes no action in response to receipt of the CUC.

[0025] Such operations in particular are applicable to ETSI Standard TS 125.331 version 3.15.0 (and other similar CDMA standards) which may be amended to implement these proposals. For instance, section 8.3.1.6 of ETSI TS 125.331 Version 3.15.0 may be amended as follows:

> If the UE after state transition enters URA_PCH or CELL_PCH state, and if a response message is to be transmitted according to subclause 8.3.1.7, it should/shall:
>
> 1> if the contents of the variable C_RNTI are empty:
> 2> set the variable INVALID_CONFIGURATION to TRUE.

An alternative amendment to the standard is as follows:

> If the UE after state transition enters URA_PCH or CELL_PCH state, and if a response message is to be transmitted according to subclause 8.3.1.7; and
>
> 1> the contents of the variable C_RNTI are empty:
>
> the UE shall check the value of V302 and continue.

[0026] In the first of these situations, rather than accepting a CUC command, CUC processing by the UE is aborted and the variable INVALID_CONFIGURATION is set to TRUE. This results in a subsequent cell update message being sent to the UTRAN or the UE returning to idle depending on the values of V302 and N302 as described in Section 8.3.1.9 of the standard. Thus, on receipt of the cell update confirm message, it is determined whether the message contains a C-RNTI and whether the message places the UE in a state that requires a response prior to entering the state. If both of these are true, the processing of the cell update confirm message may be aborted and the variable INVALID_CONFIGURATION be set to TRUE. A subsequent cell update message may be sent to the UTRAN or other processes as described above.

[0027] In the alternative, on receipt of a cell update confirm message, when it is determined that the message does not contain a C-RNTI and it is determined that the variable C_RNTI is empty. If so it is determined whether the message places the UE in a state which requires response prior to entering that state. If it does, the cell update confirm message is processed by the UE and the UE then continues with the further processes for example sending subsequent cell update message to the UTRAN or returning to idle depending on the values of V302 and N302 as described in Section 8.3.1.6 of the standard for the case where CUC places the UE in Cell_FACH with the variable C_RNTI empty.

[0028] It is to be noted that the methods as described have shown steps being carried out in a particular order. However, it would be clear to a person skilled in the art that the order of the evaluation is immaterial with respect to the operation of the method. For instance, the device may check whether a C-RNTI is included in the CUC and/or whether the message places the UE in a state requiring a response prior to entering the state before determining whether the UE has an empty C_RNTI variable. The ordering of the steps as described herein is not intended to be limiting.

[0029] In the foregoing specification, the invention has been described with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense. Any features as claimed may be used in combination or separately.

Claims

1. A method of processing a message in a mobile telecommunications device, the method comprising:

   receiving a Cell Update Confirm (CUC) message;
   determining whether the device has an empty cell identifier variable;
   when the device has an empty cell identifier variable, determining whether the CUC message includes a new value for the cell identifier;
   when the CUC message includes a new value for the cell identifier and the CUC message would cause the device to enter a state which requires the UE to respond to the message before entering the state, carrying out at least one further step prior to entering the state.

2. A method according to claim 1 wherein the further step comprises:

   setting the INVALID_CONFIGURATION to TRUE.

3. A method according to claim 2 wherein the further step further comprises:

   sending a cell update message to the network.

4. A method according to claim 2 wherein the further step further comprises:

   returning to an idle state.

5. A method according to claim 1 wherein the further step comprises:

   sending a new cell update message including a field that indicates that the cause for the cell update message is cell reselection.

6. A method according to claim 1 wherein the further step comprises:

   acting on the cell update confirm message without transmitting a response to the network.

7. A method according to claim 1 wherein the further step comprises:

   ignoring the cell update confirm message.

8. A method according to any preceding claim wherein the cell identifier variable is C_RNTI and the value of the cell identifier is C-RNTI.

9. Apparatus for processing a message in a mobile telecommunications system, the apparatus being arranged to:

   receive a Cell Update Confirm (CUC) message from a network;
   determine whether the device has an empty C_RNTI variable;
   when the device has an empty C_RNTI variable, determine whether the CUC message includes a new C-RNTI ;
   when the CUC message includes a new C_RNTI and the CUC message would cause the device to enter a state which requires the UE to respond to the message before entering the state, carrying out at least one further step prior to entering the state.

10. Apparatus according to claim 9 wherein the apparatus is further arranged to:

    set the INVALID_CONFIGURATION to TRUE.

11. Apparatus according to claim 10 wherein the apparatus is further arranged to:

    send a cell update message to the network.

12. Apparatus according to claim 9 wherein the apparatus is further arranged to:

    return to an idle state.

13. Apparatus according to claim 9 wherein the apparatus is further arranged to:

    send a new cell update message including a field that indicates that the cause for the cell update message is cell reselection.

14. Apparatus according to claim 9 wherein the apparatus is further arranged to:

    act on the cell update confirm message without transmitting a response to the network.

15. Apparatus according to claim 9 wherein the apparatus is further arranged to:

    ignore the cell update confirm message.

16. A mobile telecommunication device incorporating apparatus according to any of claims 9 to 15.

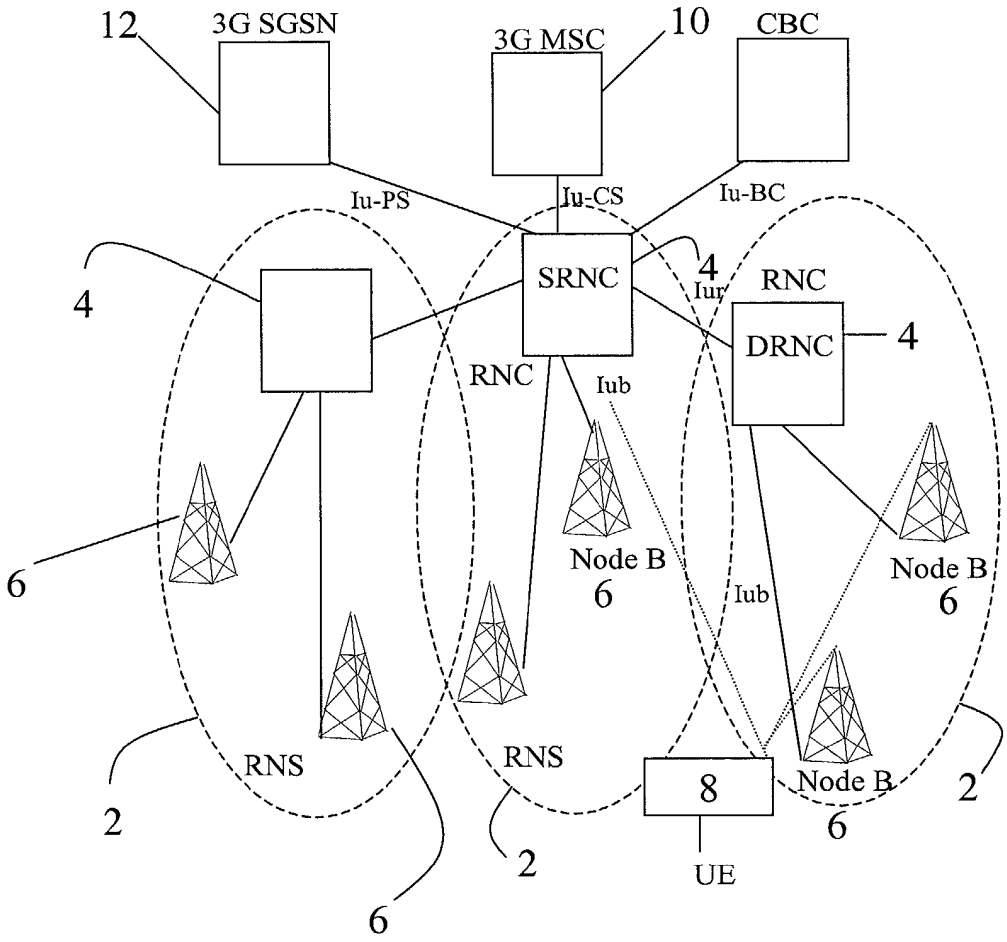
12
3G SGSN
3G MSC
10
CBC
Iu-PS
Iu-CS
Iu-BC
4
SRNC
4
Iur
RNC
DRNC
4
RNC
Iub
Node B
6
Node B
6
Iub
Node B
6
6
RNS
RNS
8
2
2
2
6
UE

Fig. 1

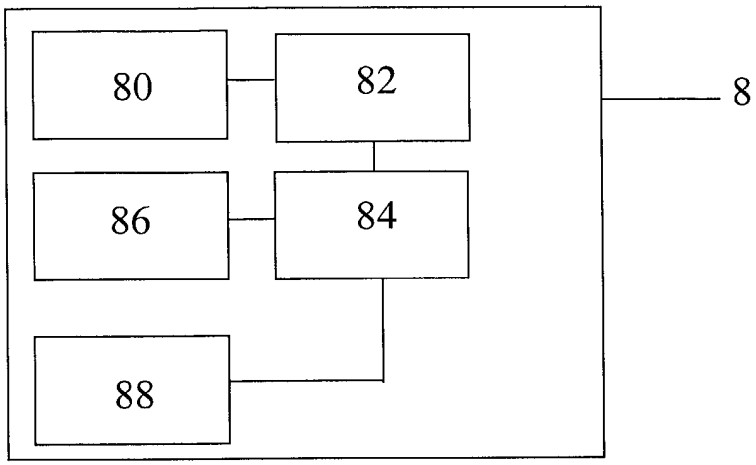
80
82
8
86
84
88

Fig. 2

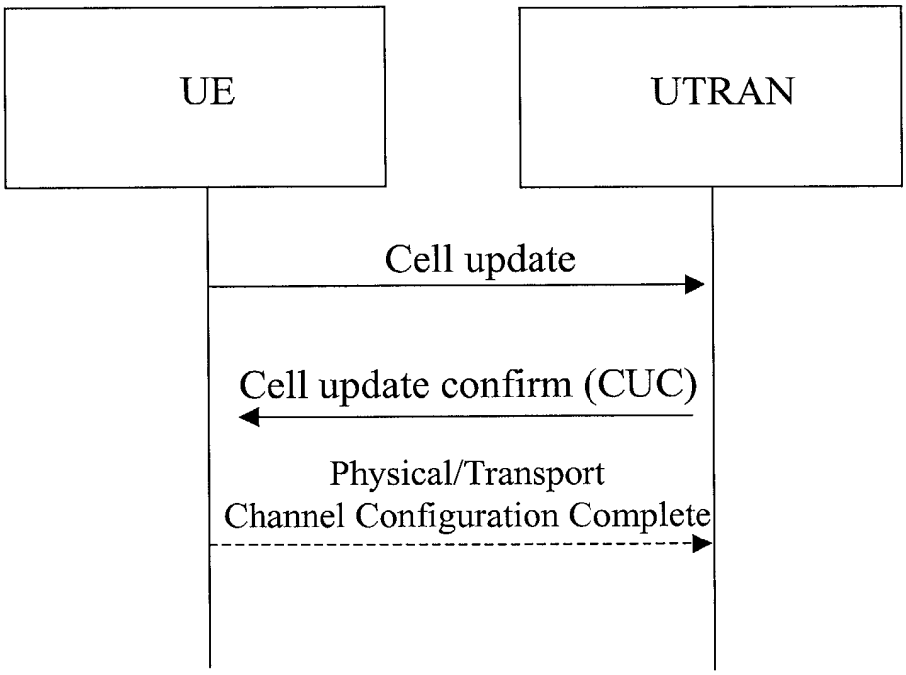
UE
UTRAN
Cell update
Cell update confirm (CUC)
Physical/Transport
Channel Configuration Complete

Fig. 3

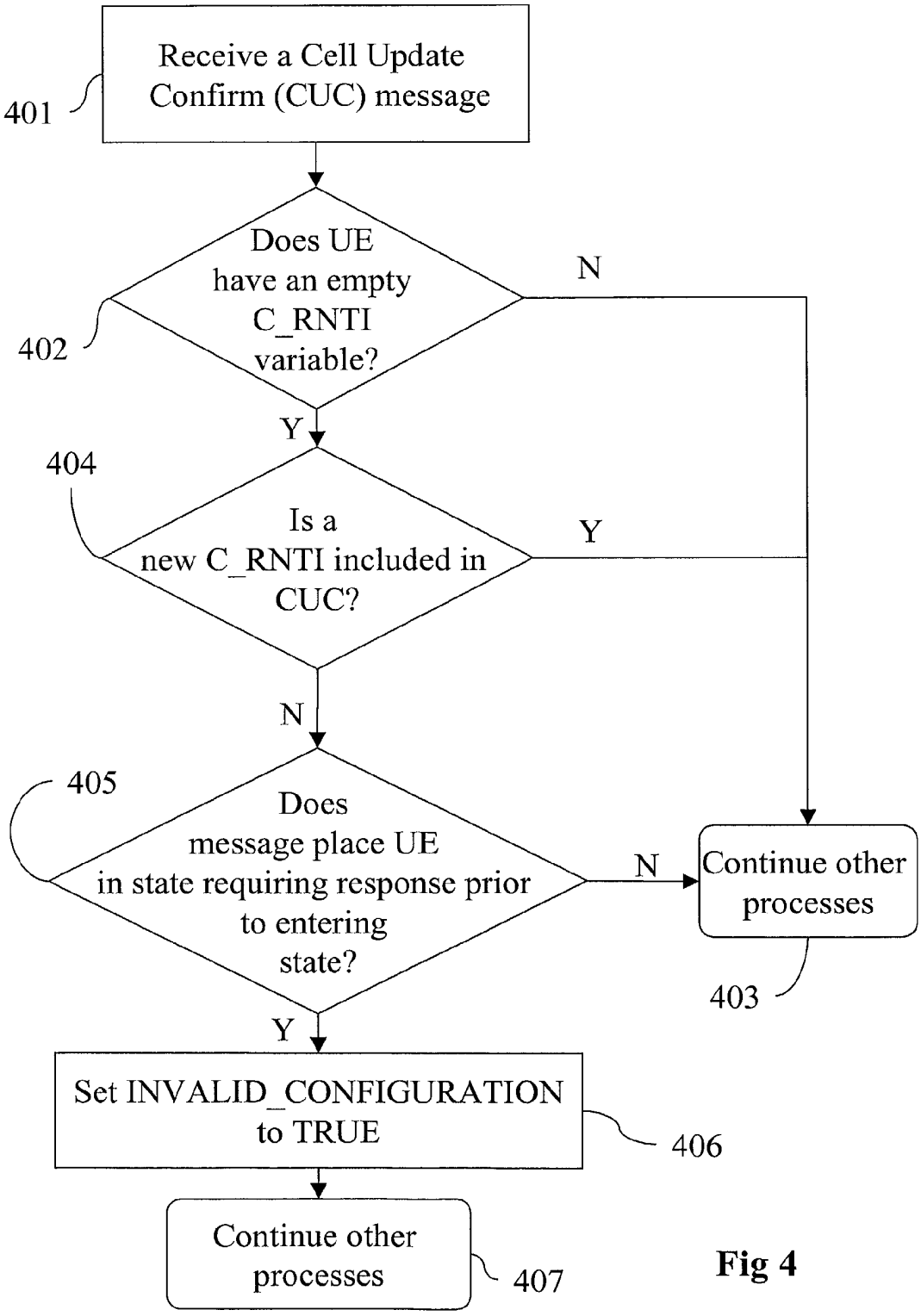
Receive a Cell Update Confirm (CUC) message
401
Does UE have an empty C_RNTI variable?
402
N
Y
404
Is a new C_RNTI included in CUC?
Y
N
405
Does message place UE in state requiring response prior to entering state?
N
Continue other processes
403
Y
Set INVALID_CONFIGURATION to TRUE
406
Continue other processes
407

Fig 4

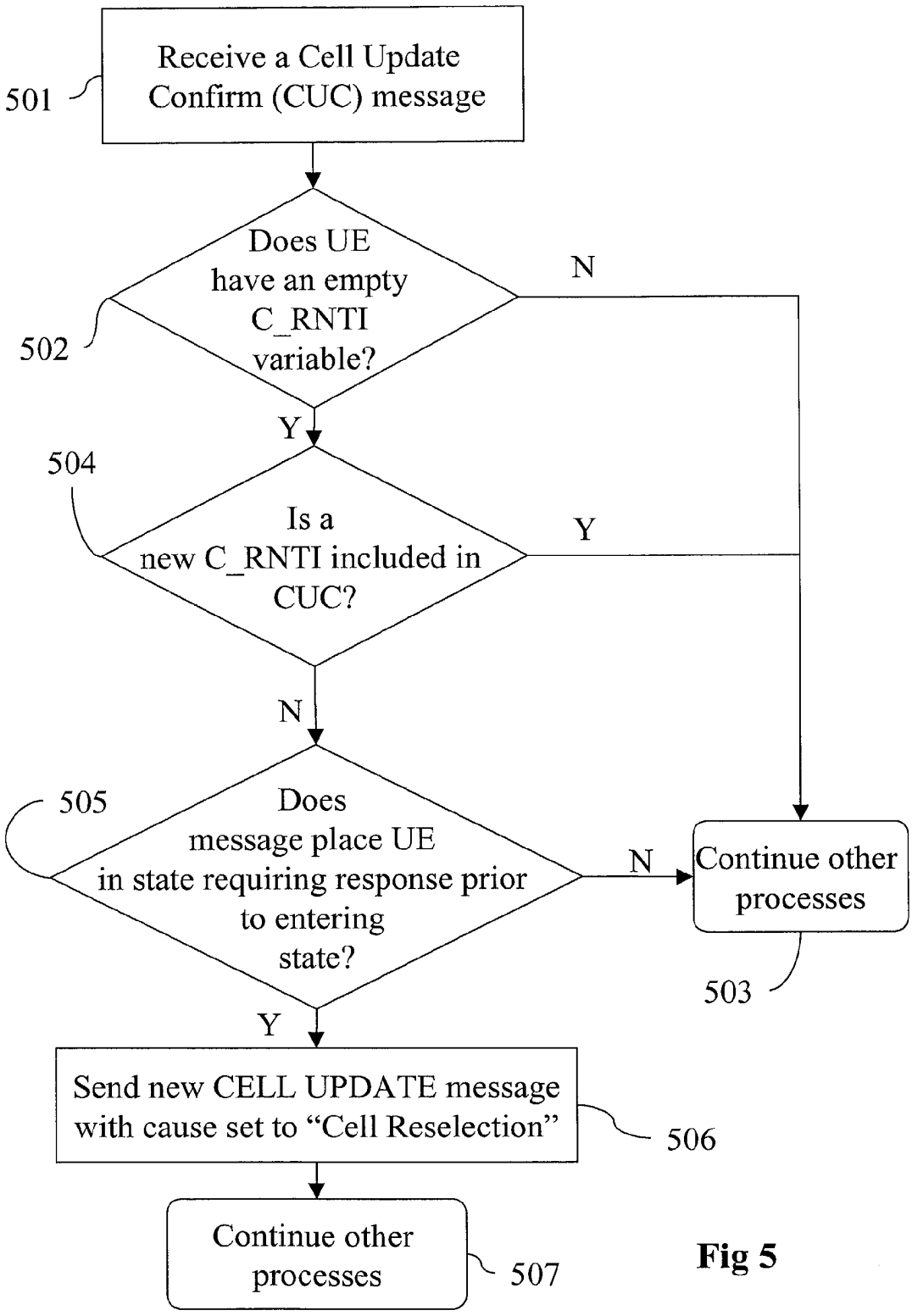
Receive a Cell Update Confirm (CUC) message
501
Does UE have an empty C_RNTI variable?
502
N
Y
504
Is a new C_RNTI included in CUC?
Y
N
505
Does message place UE in state requiring response prior to entering state?
N
Continue other processes
503
Y
Send new CELL UPDATE message with cause set to "Cell Reselection"
506
Continue other processes
507

Fig 5

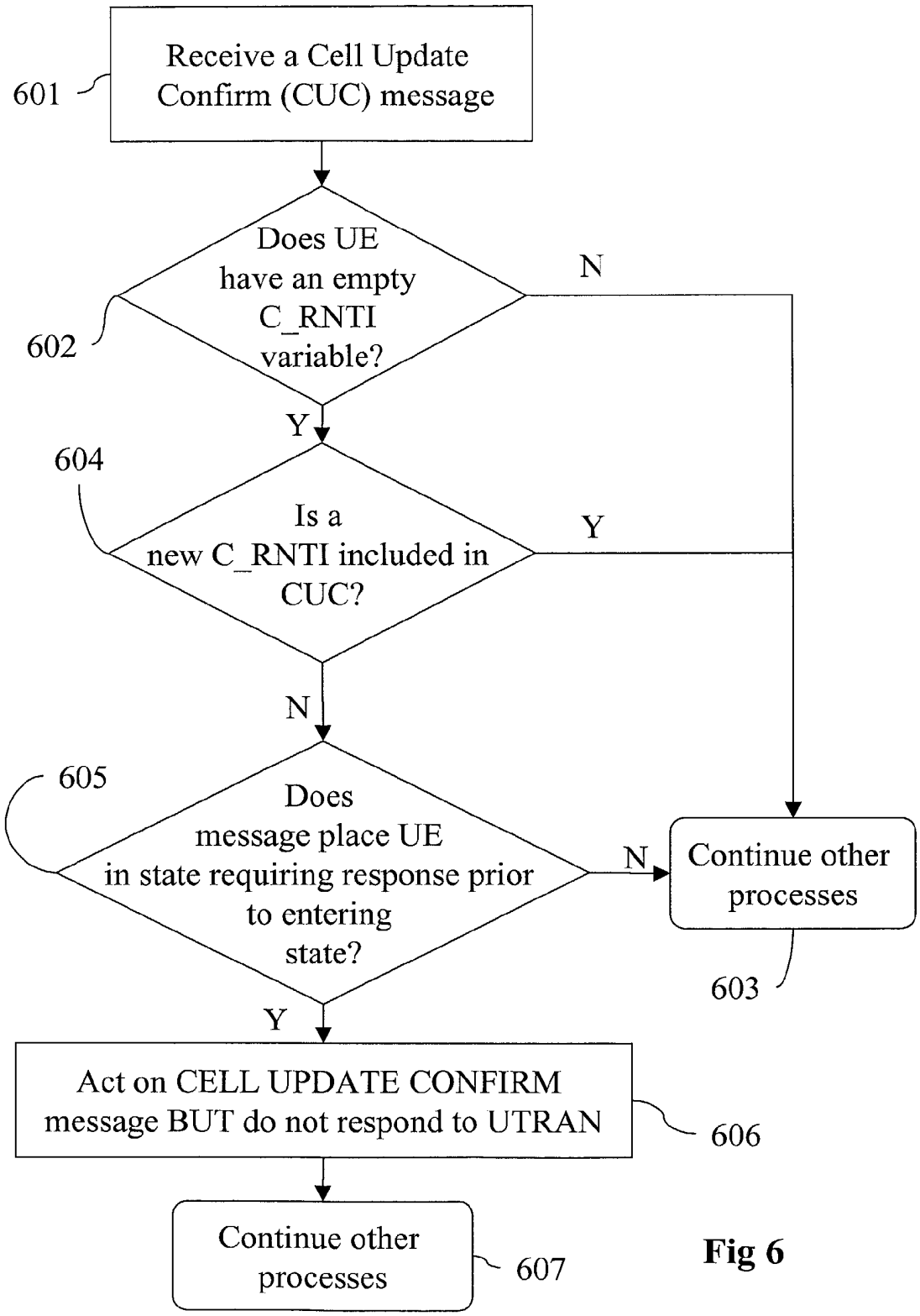
Receive a Cell Update Confirm (CUC) message
601
Does UE have an empty C_RNTI variable?
602
N
Y
604
Is a new C_RNTI included in CUC?
Y
N
605
Does message place UE in state requiring response prior to entering state?
N
Continue other processes
603
Y
Act on CELL UPDATE CONFIRM message BUT do not respond to UTRAN
606
Continue other processes
607

Fig 6

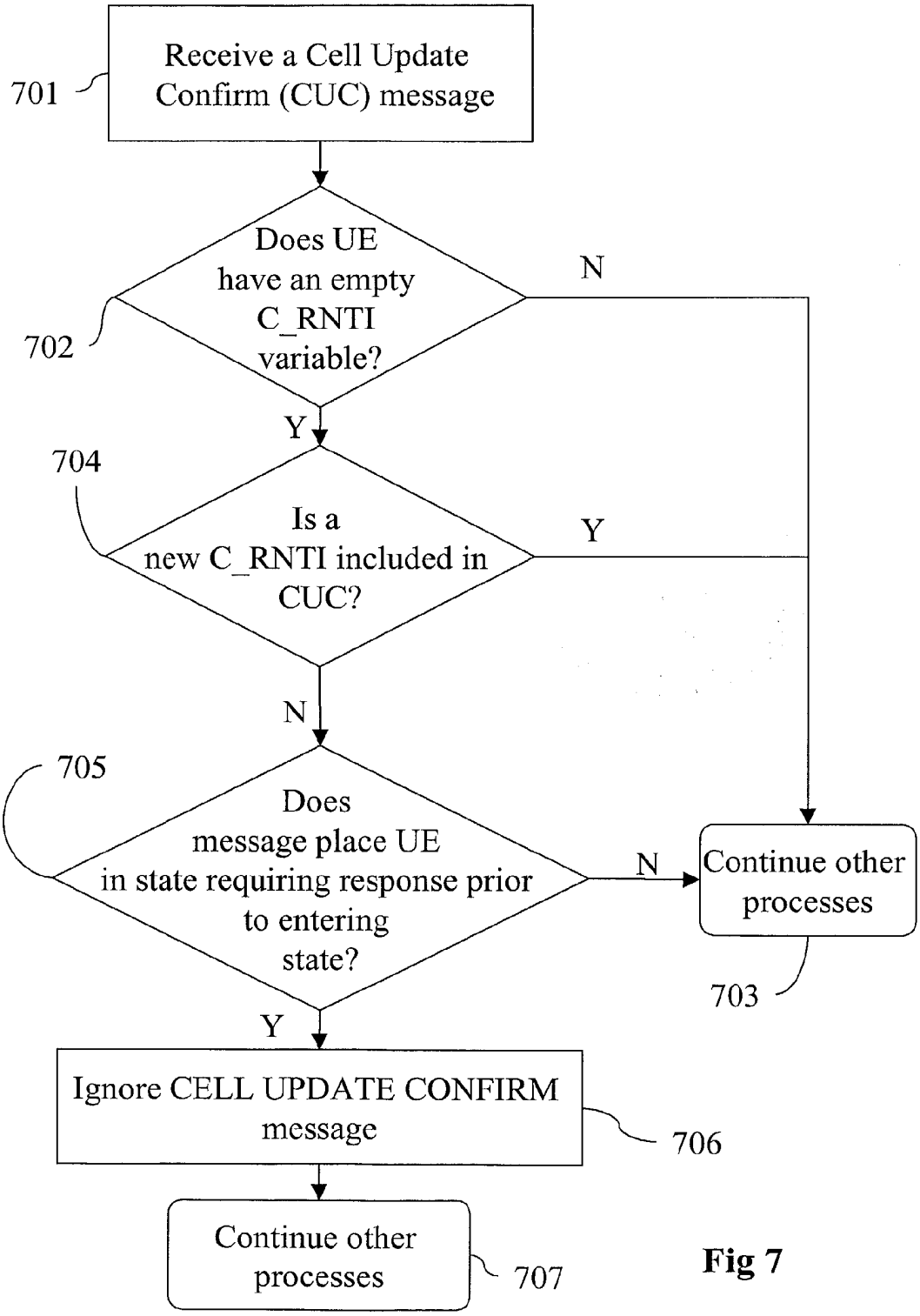
Receive a Cell Update Confirm (CUC) message
701
Does UE have an empty C_RNTI variable?
702
N
Y
704
Is a new C_RNTI included in CUC?
Y
N
705
Does message place UE in state requiring response prior to entering state?
N
Continue other processes
703
Y
Ignore CELL UPDATE CONFIRM message
706
Continue other processes
707

Fig 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 6112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	2 March 2004	Moreno-Solana, S-F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 6112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WO 00 51374 A (ERICSSON TELEFON AB L M) 31 August 2000 (2000-08-31) * abstract * * page 3, line 16 - page 5, line 20 * * page 7, line 17 - page 9, line 24 * * figures 5,8A,8B * ---	1,9	
A	WO 00 54522 A (NOKIA NETWORKS OY ;LONGONI FABIO (FI); VIALEN JUKKA (FI); HONKASAL) 14 September 2000 (2000-09-14) * abstract * * page 3, line 23 - page 4, line 25 * -----	1,9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)

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EPO FORM 1503 03.82 (P04C01)

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 25 6112

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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02-03-2004

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